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NIGHT-SKY RECORDER

BY N. K. JOHNSON, A. J. LANDER AND W. A. TOMS

For several years past the *Monthly Weather Report* of the Meteorological Office has given figures showing the number of hours each month during which certain circumpolar stars were visible at Greenwich and Porton. Both sets of results are obtained by means of a poleward-directed camera. In the case of Greenwich the camera shutter is opened and closed by a member of the staff, but as no staff is on duty at night at Porton, it was necessary to devise some mechanical form of shutter which would open and close itself at the correct times; this shutter is the key feature of the Porton instrument. The following account describes the shutter in some detail and gives an outline of the other essential parts of the apparatus.

External housing.—The camera proper is shielded from the weather by being mounted inside an outer housing, shown in Fig. 1, facing p. 204. The top portion of the cowl overhangs, and thus reduces the tendency for rain and snow to enter the frontal opening. The cowl can be lifted so as to afford easy access to the camera within. The lower end of the cowl is closed by a watertight metal sheet with a central aperture opposite the camera lens. The axis of the housing is, of course, directed to the celestial pole. In the latest design of instrument an open sight is provided to facilitate this operation.

The camera sits on two transverse supports, and access to the film-changing mechanism at the back is obtained through a large door at the lower end of the outer housing.

The inside of the housing is painted dead-black.

Camera.—The camera is constructed with mahogany sides and brass front and back. It is illustrated in Figs. 2 and 3. The front plate is provided with an optical glass window in line with the lens, and a large circular cover-plate which allows access to the timing device of the shutter (see Fig. 2). Behind the front plate is mounted the complete shutter mechanism which is described in the next section and is shown in Fig. 3 placed on top of the camera. The achromatic lens of 22-mm. aperture and 250-mm. focal length is situated behind the shutter.

At the back of the camera is fitted the body of a quarter-plate roll-film camera in which six additional windows have been made, enabling seven exposures to be obtained on an ordinary six-exposure film (see Fig. 3). The size of each negative is $3\frac{1}{4}$ in. $\times$ $3\frac{1}{4}$ in. (8·25 cm. $\times$ 8·25 cm.). A safety shutter is provided to permit adjustments to the shutter during day-time should this be necessary.

Shutter.—The earlier types of shutter which were tried aimed at opening and closing instantaneously. To achieve this it was necessary to have, in addition to the controlling clock, some other source of power, either electrical or mechanical, since no ordinary clock possesses sufficient power for the purpose. This arrangement also needed some form of indicator to show whether the mechanism was functioning correctly, since otherwise failure of the shutter would remain undetected until the film was developed at the end of the week.

The present design of shutter operates from the power of an ordinary daily clock as used in the standard recording instruments of the Meteorological Office. Its mode of operation can be seen from Fig. 3. The clock spindle carries the 24-hour dial A which is read against the index B. The two striking arms C and D are also carried on the clock spindle to which they are locked by the milled nut E which permits their being set to operate at selected times. In the course of their rotation, the plain ends of the striking arms engage a tooth of the eight-point star-wheel F and turn it an eighth of a revolution. The rotary shutter G consists of a circular disc containing a single aperture, and is connected to the star wheel by the 4 : 1 gear wheels of which one can be seen at H. In this way the passage of each striking arm rotates the shutter half a revolution, the first opening it and the second closing it. To prevent accidental movement of the shutter due to vibration or other cause, a light spring catch is arranged to engage the teeth of one of the gear wheels.

The shutter is in motion for about half an hour at each of the operations of opening and closing, but actually begins to admit light after about 20 minutes of action in the first case and completely covers the lens aperture after about 10 minutes in the second case. These time lags are allowed for in the setting tables.

The striking arms are set once a week and provide for the shutter being open during the period that the sun is 10 degrees below the horizon. Allowance is made for the lags just mentioned, and also for the increasing length of day during the first half of the year, which necessitates the setting being computed for the end of the week instead of the beginning. Times computed in this way are embodied in permanent setting tables.

The clock-winding key is placed at the back of the camera at J.

Method of analysing the records.—A typical starshine record is shown in Fig. 4, facing p. 205. The bright arc near the centre is the track of the Pole Star (α Ursæ Minoris), and the second brightest is that of δ Ursæ Minoris. The original negative shows about 20 additional stars within its field which embraces a circumpolar area of about 9 degrees radius. Until March 1932, the length of the Pole-Star trace only was measured, but since that date δ Ursæ Minoris has also been included in the analysis.

The measurement of the traces is carried out by means of a glass scale shown in Fig. 5. The radial lines are spaced at 15 degrees apart and therefore

represent hourly intervals. The two annular markings are drawn with radii corresponding to the polar distances of the two stars to be measured and are used for centring the negative correctly on the scale. In practice it has been found convenient to build the scale into the top of a sloping desk and to illuminate it from below, the film being then laid over the scale.

The beginning and end of the starshine traces are measured, to the nearest tenth of an hour, relative to the lower edge of the film which corresponds to upper culmination, the times of upper culmination of the two stars being obtained from the *Nautical Almanac*. The analyses for each individual night in a month are drawn in the form of a chart as shown in Fig. 6, the central portion of which shows the corresponding sunshine record for each day. The gaps around sunrise and sunset correspond to the twilight intervals during which neither starshine nor sunshine recorder is working.

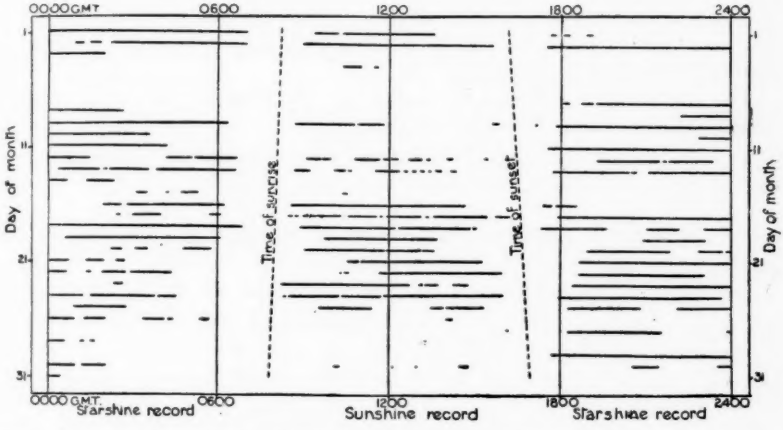


FIG. 6—CHART SHOWING COMBINED STARSHINE AND SUNSHINE RECORDS AT PORTON FOR JANUARY 1947

The analysis of the records is also tabulated to show the total duration of starshine each night. The results are summed for the month, and this total is expressed as a percentage of the total time during which the camera shutter has been open. The monthly total and percentage constitute the form in which the results are published in the *Monthly Weather Report*.

Significance and value of night-sky records.—It is unfortunate that the photographic records given by the night-sky camera do not permit a direct determination of the type of cloud present. The traces of both α and δ Ursæ Minoris are obliterated by cirrus.* Nor does there seem to be any prospect of overcoming this by adopting a large aperture lens or by any other simple means. In many cases, however, the type of cloud in the sky at night can be inferred from the observations made at 1800 and 0700. The night-sky camera and the observation log book are thus complementary. Employed in this

*Bright moonlight obliterates all star traces except those of α and δ Ursæ Minoris. It is therefore not possible, as has been suggested, to estimate the nocturnal visibility from the number of star traces recorded.

way, the night-sky camera should prove of value in such problems as investigating the times of incidence and dispersion at night of clouds of various types—including fog.

In addition to such statistical uses, the night-sky record is also valuable at meteorological research stations where investigations of an observational nature are in progress. Examples of this are given in *Geophysical Memoirs* Nos. 46 and 77, where the night-sky record was employed in selecting occasions for determining the vertical lapse rate of temperature with clear and overcast skies and for showing the time of formation of radiation fog in an investigation of the thermal processes associated with this phenomenon. Even with its known limitations, therefore, the night-sky camera should prove a valuable instrument both for collecting statistical information about the state of the sky and also in the study of radiation and other problems.

Location of night-sky recorders.—Fifteen instruments have been made and nine are now in operation at the observatories at Kew, Eskdalemuir and Lerwick, and at Church Fenton, Cambridge, Stornoway, Pembroke Dock, Rye and Aldergrove.

The remaining six instruments are to be installed at Aberdeen, Bangor, Dalwhinnie, Elmdon, Penzance and Valentia.

The above are additional to the original instruments at Greenwich and Porton, which are still in operation.

INTERGOVERNMENTAL MARITIME CONSULTATIVE ORGANIZATION

BY COMMANDER C. E. N. FRANKCOM, R.N.R.

In Geneva, in March 1948, a new international organization was born. In the Palace of Nations, delegates of 34 nations which own shipping or are actively concerned in international trade, took part in a conference convened by the United Nations Organization, the object of which was to form this new international maritime organization. The International Meteorological Organization (I.M.O.) was represented at the Conference by Commander Frankcom, President of the Maritime Commission.

It is interesting to note that, despite the essentially international nature of the shipping industry, there has never before been any permanent international shipping organization having Government status. International conferences on shipping problems—notably on Safety of Life at Sea—have been held from time to time, and a Safety of Life at Sea Convention has been in existence for many years, but there has been no permanent organization to deal with problems as they arise.

The new organization will provide the necessary machinery for co-operation between Governments in all technical matters concerning shipping engaged in international trade, especially those concerned with the efficiency of navigation and the safety of life at sea. It will also be concerned with such commercial matters as the removal of discrimination and other restrictions on shipping.

The title of the new organization, "The Intergovernmental Maritime Consultative Organization", may not appear too felicitous, but the reasons for this choice were largely to indicate the relatively restricted nature of its activities.

The relationship between the International Meteorological Organization and this new body might seem, at first, a trifle obscure. When one realises, however, that this new maritime organization will deal with matters concerning safety of life at sea, the I.M.O.'s presence at the meeting will become clear. Readers of this magazine may not be familiar with the close association that international meteorology has had with shipping and the following points are of interest.

It was in 1853 that the first International Meteorological Conference was held in Brussels and the prime mover in this Conference was an American naval officer, Matthew Fontaine Maury. The chief purpose of this Conference was to consider international co-operation amongst merchant shipping in order to obtain information about the meteorology and currents of the oceans. Shortly after that date the British Meteorological Office was formed under Admiral Fitzroy and at that time, too, the prime purpose of the Meteorological Office was to safeguard shipping.

Since the days of Maury and Fitzroy the scope of meteorology has extended into many other spheres, notably that of aviation, but meteorology has still a very important part to play in its relation to shipping. Gales still produce high seas; fogs set in with disturbing regularity; in certain regions of the world ice is still a great menace to shipping; and the navigator continues to seek information which will prevent his vessel being set off her course by unsuspected currents.

Despite mechanical propulsion, larger vessels and all the scientific aids now available to the seaman, the navigator must still be as vigilant as ever he was in the days of the sailing ship, in fact, even more so, as he has higher speeds to contend with, and even the largest ship can be damaged by a heavy sea. The provision of accurate and regular meteorological information for shipping is a permanent necessity—not only for safety of life and property at sea—but also for commercial reasons.

The I.M.O. has realised this fact, as well as the very practical consideration that co-operation by ships is essential if a reasonable network of observations from the greater part of the globe's surface—the oceans—is to be attained. Assisted by the technical advice of the Maritime Commission, the I.M.O. has continued to display a very active interest in shipping matters and has taken part at the various conferences which have been held on the subject of safety of life at sea.

The I.M.O. representative, in his address to the Conference, stressed these facts, and emphasised the I.M.O.'s desire, as a servant of the world, to provide the best possible meteorological service for the shipping of all nations in all oceans.

Both the above-mentioned Conferences on Safety of Life at Sea have been held in London, the first one being in 1914 as a result of the *Titanic* disaster, and another in 1929.

At this last-named Conference the present International Convention for Safety of Life at Sea evolved and another Conference was held in London, in May and June this year, to revise this Convention (see report on p. 198). This Conference was linked up with the functions of the newly formed Intergovernmental Maritime Consultative Organization.

In 1912, the International Meteorological Organization was instrumental in arranging an International Conference on the subject of storm warnings; this was also held in London.

With the object of ensuring adequate co-ordination in matters concerning safety of life at sea, in preparation for the Conference in London, a Preparatory Committee of Experts was formed and met in London in February of this year. At this Conference, the International Civil Aviation Organization, the International Telecommunication Union, the International Meteorological Organization, and the Provisional Maritime Consultative Council took part, and a scheme was drawn up whereby each organization agreed to consult the others as necessary concerning matters within their scope affecting safety at sea.

The Convention of the Intergovernmental Consultative Organization needs to be ratified by Governments before it can officially take any action. When one considers the importance of shipping to world prosperity, the potential value of the new organization will be obvious, and it is hoped that its birth will not only contribute to greater safety of life at sea but to a greater understanding among the shipping nations of the world.

INTERNATIONAL CONFERENCE ON SAFETY OF LIFE AT SEA, LONDON, 1948

BY COMMANDER C. E. N. FRANKCOM, R.N.R.

The third International Conference on Safety of Life at Sea was held in London under the chairmanship of Sir John Anderson, from April 23 to June 10, 1948. The Conference took place at the Institute of Civil Engineers and was attended by thirty nations. Admiral Farley (Chief of the U.S. Coastguard Service) was elected Vice-Chairman.

The writer attended the Conference as an official observer for the International Meteorological Organization. The meteorological interest in this subject is quite considerable and it will be evident to readers of this article that safety at sea is necessarily closely related to weather conditions. In the days of the sailing ship it is true that weather played an even greater part in the life of the seaman, for the winds provided the motive power. Even today, however, as will be seen from the study of any reports of shipping casualties weather still plays an important part in the shipping industry. Even the largest ship can get damaged if she tries to steam at full speed into a heavy sea. Comparatively minor damage done to the steering apparatus of a ship may make her helpless in heavy weather and thereby make her a casualty. Despite modern, scientific aids to navigation, many ships collide or run ashore in thick weather and ships get beset in ice every year in the Baltic. A vessel which has deficient stability may, in heavy weather, shift her cargo, take a dangerous list and eventually capsize. Temperate-zone gales and tropical storms exact their annual toll of ships and of seamen's lives—rather particularly in the case of the smaller coasting type of vessel—despite the provision of modern life-saving appliances and the heroic work of the lifeboats and other safety services (including aircraft searches).

The first International Conference on Safety of Life at Sea was convened as a result of the *Titanic* disaster and took place in London in 1914. The results of this first Conference never bore fruit because the 1914–18 war intervened, and

the Convention was never ratified. In 1929, however, another Conference was held and the International Convention for Safety of Life at Sea was instituted.

The 1948 Safety Conference dealt with many matters concerning safety at sea, such as standards of construction of ships, strength of materials, stability, life-saving appliances aboard ships, rule of the road at sea, and radio, including electronic aids to navigation. The general atmosphere of the Conference was one of cordiality and of an earnest desire by all concerned to ensure that those who go down to the sea in ships should not be lacking in adequate provisions to ensure that their voyages should be conducted with safety. Lessons learnt during the recent war, coupled with the advance of scientific knowledge in the interval since the 1929 Convention, have done much to raise safety standards, and the provisions of the new Convention contain many notable advances.

Much of the subject matter dealt with precautions to ensure safety after a casualty had occurred. The meteorological provisions of the Convention are, however, largely designed in an endeavour to give warning of approaching danger, so that the mariner can take seamanlike precautions to avoid it.

Article 34 of the 1929 Convention placed upon masters of ships an obligation of informing other shipping and meteorological services of the presence, or suspected presence, of tropical storms, and Article 35 provided for the collection from ships of radio-weather messages and the issue to ships of weather forecasts and other meteorological information, as necessary.

At the Conference this year, the meteorological provisions of the Convention were further strengthened and the texts of the latest Articles on this subject read as follows:—

REGULATION 3.—Information Required in Danger Messages

The following information is desired in danger messages, the time in all cases being Greenwich Mean Time:

(*a*) Ice, derelicts and other direct dangers to navigation.

(i) the kind of ice, derelict or danger observed;

(ii) the last position of the ice, derelict or danger when last observed;

(iii) the time and date when the observation was made.

(*b*) Tropical storms—(hurricanes in the West Indies, typhoons in the China Sea, cyclones in Indian waters, and storms of a similar nature in other regions).

(i) A statement that a tropical storm has been encountered. This obligation should be interpreted in a broad spirit, and information transmitted whenever the master has good reason to believe that a tropical storm exists in his neighbourhood.

(ii) Meteorological information. Each shipmaster should add to his warning message as much of the following meteorological information as he finds practicable:—

Greenwich Mean Time, date and position of the ship when the observations were taken;

barometric pressure (stating millibars, inches, or millimetres, and whether corrected or uncorrected);

barometric tendency (the change in barometric pressure during the past 3 hours);

true wind direction;

wind force (Beaufort scale);

state of the sea (smooth, moderate, rough, high);

swell (slight, moderate, heavy) and the true direction from which it comes—period or length of swell (short, average, long) would also be of value;

true course and speed of ship.

(*c*) Subsequent observations. When a master has reported a tropical or other dangerous storm, it is desirable, but not obligatory, that other observations be made and transmitted hourly, if practicable, but in any case at intervals of not more than three hours, so long as the ship remains under the influence of the storm.

Examples

Ice

TTT Ice. Large berg sighted in 4605 N., 4410 W., at 0800 G.M.T. May 15.

Derelict

TTT Derelict. Observed derelict almost submerged in 4006 N., 1243 W., at 1630 G.M.T. April 21.

Danger to Navigation

TTT Navigation. Alpha lightship not on station. 1800 G.M.T. January 3.

Tropical Storm

TTT Storm. 0030 G.M.T. August 18. 2204 N., 11354 E. Barometer corrected 994 millibars, tendency down 6 millibars. Wind NW., force 9, heavy squalls. Heavy easterly swell. Course 067, 5 knots.

TTT Storm. Appearances indicate approach of hurricane. 1300 G.M.T. September 14. 2200 N., 7236 W. Barometer corrected 29·64 inches, tendency down ·015 inches. Wind NE., force 8, frequent rain squalls. Course 035, 9 knots.

TTT Storm. Conditions indicate intense cyclone has formed. 0200 G.M.T. May 4. 1620 N., 9203 E. Barometer uncorrected 753·3 millimetres, tendency down 5 millimetres. Wind S by W., force 5. Course 300, 8 knots.

TTT Storm. Typhoon to south-east. 0300 G.M.T. June 12. 1812 N., 12605 E. Barometer falling rapidly. Wind increasing from N.

REGULATION 4.—Meteorological Services

(*a*) The contracting Governments undertake to encourage the collection of meteorological data by ships at sea and to arrange for their examination, dissemination and exchange in the manner most suitable for the purpose of aiding navigation. Administrations shall encourage the use of instruments of a high degree of accuracy, and shall facilitate the checking of such instruments upon request.

(*b*) In particular, the contracting Governments undertake to co-operate in carrying out, as far as practicable, the following meteorological arrangements:—

(i) To warn ships of gales, storms and tropical storms, both by the issue of radio messages and by the display or appropriate signals at coastal points.

(ii) To issue daily, by radio, weather bulletins suitable for shipping, containing data of existing weather and ice conditions, forecasts, and when practicable, sufficient additional information to enable simple weather charts to be prepared at sea.

(iii) To prepare and issue such publications as may be necessary for the efficient conduct of meteorological work at sea.

(iv) To arrange for selected ships to be equipped with tested instruments (such as a barometer, a barograph, a psychrometer and suitable apparatus for measuring sea temperature) for use in this service, and to take meteorological observations at standard synoptic hours (at least four times daily, whenever circumstances permit) and to encourage other ships to take observations in a modified form, particularly when in areas where shipping is sparse; these ships to transmit their observations by radio for the benefit of the various official meteorological services, repeating the information for the benefit of ships in the vicinity. When in the vicinity of a tropical storm or of a suspected tropical storm, ships should be encouraged to take and transmit their observations at more frequent intervals whenever practicable, bearing in mind navigational preoccupations of ships' officers during storm conditions.

(v) To arrange for the reception and transmission by coast radio stations of weather messages from and to ships. Ships which are unable to communicate direct with shore should be encouraged to relay their weather messages through ocean weather ships or through other ships which are in contact with shore.

(vi) To encourage all masters to inform ships in the vicinity and also shore stations whenever they experience a wind speed of 50 knots or more (force 10 on the Beaufort scale).

(vii) To endeavour to obtain a uniform procedure in regard to the international meteorological services already specified, and, as far as is practicable, to conform to the recommendations made by the International Meteorological Organization, to which the contracting Governments may refer for study and advice any meteorological question which may arise in carrying out the present Convention.

(*c*) The information provided for in this Regulation shall be furnished in form for transmission and transmitted in the order of priority prescribed by the Radio Regulations, and during transmission " to all stations " of meteorological information, forecasts and warnings, all ship stations must conform to the provisions of the Radio Regulations.

(*d*) Forecasts, warnings, synoptic and other meteorological reports intended for ships shall be issued and disseminated by the national service in the best position to serve various zones and areas, in accordance with mutual arrangements made by the contracting Governments concerned.

The meteorological interest in the Conference also extended to the question of radio-telegraphy and radio-telephony, owing to the important part that communications play in this subject generally. A resolution was passed urging governments to ensure that the transmission of radio weather messages should be free of cost to shipping.

The continuance of the International Ice Patrol in the Grand Bank of Newfoundland district, which is entrusted to the U.S. Coastguard was a further item of considerable interest to meteorologists.

The general result of the Conference was extremely satisfactory and the new convention should do much to prevent loss of life and property at sea in the future.

ANOMALIES OF BAROMETRIC PRESSURE AT COASTAL STATIONS

BY A. W. LEE, D.SC.

Discrepancies have frequently been noted between the mean-sea-level pressures obtained from the barometric readings at certain coastal stations and the corresponding values indicated from the synoptic charts. The observed pressures for these stations appear to be too low, especially during strong winds. In some cases, such as Dungeness or Portland Bill where the barometers are set up in lighthouses, it has been suggested* that the action of wind upon such a building produces a suction or " chimney " effect and that in consequence the mean pressure inside is lower than that outside. The discrepancy has also been noted, however, in the readings for other coastal stations at which the pressures are obtained from barometers housed in more ordinary structures; accordingly a more general explanation was required and A. F. Crossley† has suggested that the anomalies may indicate the variations of pressure accompanying distortion of the air flow on sites which are over-exposed to the wind. Crossley showed that a reasonable increase of wind speed would be associated with a pressure change of the right order of magnitude but, in replying to the discussion on the paper, remarked that there were no observations then available for comparison.

This question came forward again in 1943 when the Meteorological Office issued instructions for the inspection of St. Abb's Head, emphasising that the station had frequently shown anomalies, the barometer appearing too low. It was therefore decided to try to carry out systematic determinations of the barometer which, although of necessity in a well exposed building at a height of 280 ft. above sea level, would not be described as in an abnormal situation; the results obtained are set out in the following paragraphs.

*London, Meteorological Office, Gazetteer of British meteorological stations used in the preparation of synoptic reports. London, 1931.

†CROSSLEY, A. F.; Note on the variation of pressure accompanying a distortion of air flow. *Quart. J. R. met. Soc., London*, **64**, 1938, p. 477.

For any station the barometric error (" observed " minus " true " pressure) at any time is taken as the difference between the observed value and that estimated from the isobaric distribution of the corresponding synoptic chart. The general trend of the isobars on the chart should not be influenced by the observation under comparison, or by reports from adjacent stations which are liable to be influenced by similar errors. Thus it was frequently necessary to smooth and redraw the isobars around the station before estimating the " true " pressure. Individual values of the errors obtained in this way are liable to uncertainties up to about 0.5 mb., but these are not systematic and would be eliminated with a sufficiently large number of determinations.

The " observed " and " true " pressures at St. Abb's Head have been compared at each of the hours 0100, 0700, 1300 and 1800, during the months January to July 1943. It was found that on 356 of the 848 occasions the difference between the " observed " and " true " pressures was less than 0·5 mb.; deviations exceeding this limit occurred on the following numbers of occasions:—

	mb.	Low	High
Exceeding	±0·5	470	22
Exceeding	±1·0	274	9
Exceeding	±2·0	63	1
Exceeding	±3·0	13	0

There is a striking preponderance of barometric readings which are too low, the median of the error, computed from the 848 observations, amounting to −0·7 mb.

The deficit in the observed pressures was examined for diurnal and seasonal variations by summarising the data for the various hours and for winter and summer months respectively. The diurnal variation is small; the median error of the 212 values amounts to −0·7 mb. at 0100, to −0·8 mb. at 0700, to −0·6 mb. at 1300 and again to −0·6 mb. at 1800, and a more extensive series of comparisons would be needed before it can be accepted as of physical significance. The median error of the seasonal variation amounts to −0·8 mb. in the months January to March and to −0·5 mb. from May to July; thus the values for the two sequences of months support the hypothesis that the differences are associated with the airflow, the median values of wind force and of barometric discrepancy both being greater in winter.

A close relation between barometric discrepancy and wind is brought out from the following tabulation giving the medians of the errors associated with specified ranges of speed:—

Beaufort force	0	1	2	3	4	5	6	⩾7
Median error	−0·4	−0·4	−0·3	−0·5	−0·9	−1·5	−1·7	−1·9
Number of values	32	88	112	214	216	123	43	20

The uniformity of the errors for calms and for winds up to Beaufort force 3 suggests that the results may all be subject to a systematic error of −0·4 mb.; this is equivalent to an error of about 10 ft. in the height of the barometer above sea level. With stronger winds, the barometric error attributed to exposure is apparently superposed and increases progressively with the speed.

Fig. 1 shows the anomalies of pressure at St. Abb's Head from January to July 1943 classified according to wind speed and direction; medians of the error are given for all cases except those with less than four observations. The increase of barometric anomaly with wind speed is shown in all directions from which data are available, but unfortunately moderate or strong winds were infrequent or lacking from some directions during the period covered by the observations.* The station is surrounded by sea from west-north-west through north and east to south-south-east, and it is notable that for each range of forces the barometric anomalies are generally larger with winds from landwards than with those from seawards.

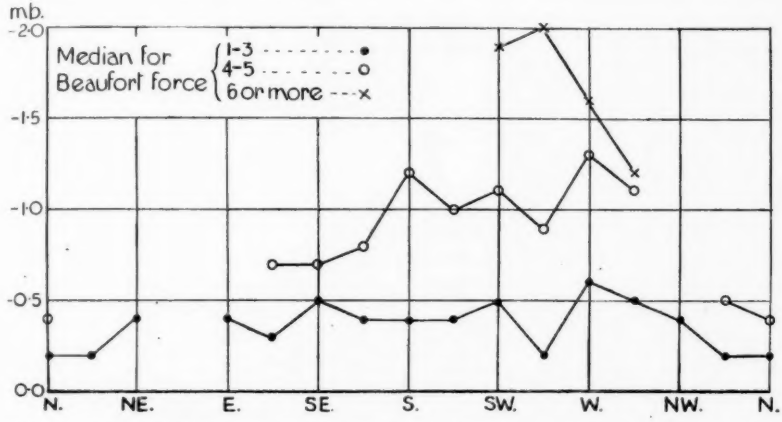


FIG. 1—ANOMALIES OF PRESSURE AT ST. ABB'S HEAD, JANUARY–JULY 1943

Classified according to wind speed and direction

Thus, since anomalies of 2 mb. or more are associated with landward winds, there seems to be no reason to believe that such anomalies occur only at coastal stations. Anomalies might also be expected to occur at well exposed inland stations, especially those at considerable heights above sea level in irregular hilly country. Also, it seems reasonable to suspect that many other barometers may also be anomalous; even if the discrepancy generally amounted to several tenths of a millibar, it would be by no means negligible in view of the consistency claimed for barometric measurements.

METEOROLOGICAL RESEARCH COMMITTEE

The third meeting of the Physical Sub-Committee was held on July 15. One of the papers considered dealt with the evidence from upper air temperature measurements by aircraft for diurnal variation of temperature in the upper air. It was concluded that these measurements do not provide evidence of such variation.

*An earlier unpublished comparison by B. C. V. Oddie of the barometric pressures at St. Anne's Head in south-west Wales with those at Pembroke Dock 10 miles away showed discrepancies of approximately the same magnitudes as at St. Abb's Head.

Another paper *M.R.P.* No. 402 by Dr. R. Frith, described a series of flights by Meteorological Research Flight aircraft during which the aircraft flew along a grid-pattern path covering an area approximately 30 to 50 miles square. Very frequent measurements of temperature and humidity were made. When these measurements were subsequently plotted it was found that isopleths of temperature and humidity could be drawn showing a coherent pattern in which isopleths of high temperature were very approximately coincident with isopleths of low humidity. Investigation of these grid patterns is to continue.

ROYAL METEOROLOGICAL SOCIETY

The 1948 summer meeting of the Royal Meteorological Society was held at the Rothamsted Experimental Station, Harpenden, on July 14.

Most of the Fellows and their guests travelled from London by coach, reaching Rothamsted soon after 11.30 a.m. On arrival the party was split into three groups, each of about twenty, and during the day everybody visited the Farm, the Plant Pathology Department, the Physics Department and the Meteorological Enclosure.

Miss Skidmore conducted the party round part of the farm and gave a general description of the experiments which have been continuously carried out since the middle of the last century. In Broadbalk Field, wheat has been grown every year since 1843, and in 1852 an experiment was started to find the effect of different manurial treatments on 17 long parallel strips, each about half an acre in area. Not until 1925 was any change made in the experiment when it became necessary to fallow one-fifth of the field each year because it had become badly infested with weeds, particularly poppies and black bent. The difference in the yields of the various strips was evident even to untrained eyes, and it was not surprising to hear that the strip with 14 tons of farm manure to the acre bore about 3 times as much as the strip with no manure whatever and 2½ times as much as the strip which received no nitrogen. On the other hand, the strip with 6 cwt. of sulphate of ammonia, 3½ cwt. of superphosphate, 2 cwt. of sulphate of potash and 1 cwt. of sulphate of magnesia per acre has roughly the same yield as the strip with farm manure.

The analysis of the water from the tiled drains which were laid down under each strip has provided important data on the losses of the constituents of the various manures. For all practical purposes, phosphate and potash are completely retained in the soil, but nitrate and calcium carbonate come through into the drains and are lost to the plants. Gardeners in the party no doubt made a note to apply their sulphate of ammonia in the spring and not in the autumn.

A different experiment was begun in 1882 on an acre strip of the standing crop in the west of Broadbalk Field. This crop was left standing and allowed to compete with the weeds; four years later a few stunted plants were found and were barely recognizable as cultivated wheat. Since then the weeds have completely taken possession and transformed the strip into what is known as the Wilderness. Part of this is left completely untouched and now carries a dense growth of bushes and young trees, and the rest is periodically cleared of bushes to allow the ground vegetation to develop.

[*To face p.* 204

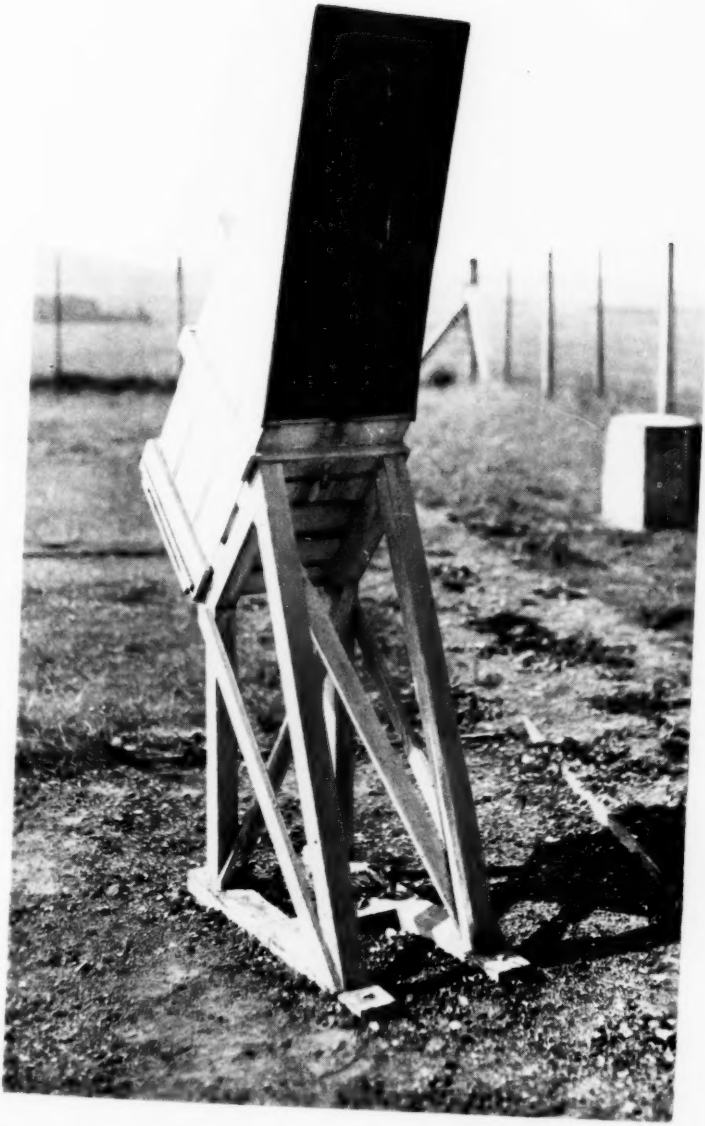


FIG. 1—EXTERNAL HOUSING OF STARSHINE CAMERA

(see p. 193)

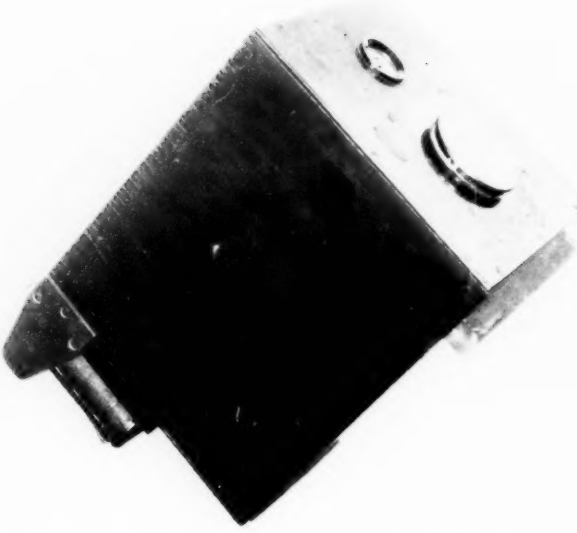


FIG. 2—COMPLETE CAMERA

(see p. 194

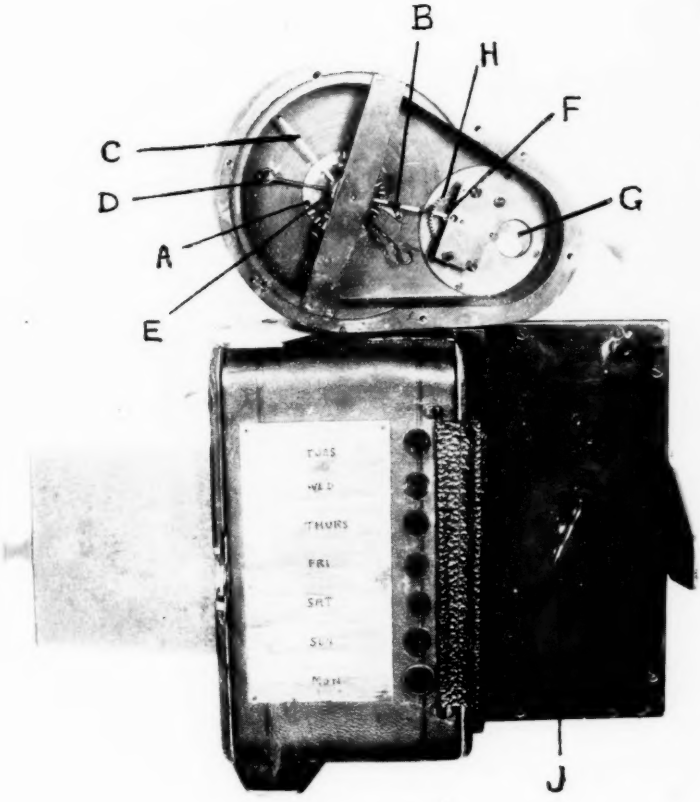


FIG. 3—BACK OF THE CAMERA WITH SHUTTER MECHANISM PLACED ON TOP

A	24-hour dial	F	8-point star wheel
B	Time index	G	Rotary shutter
C, D	Striking arms	H	Gear wheel
E	Milled locking nut	J	Clock-winding key

(see p. 194)

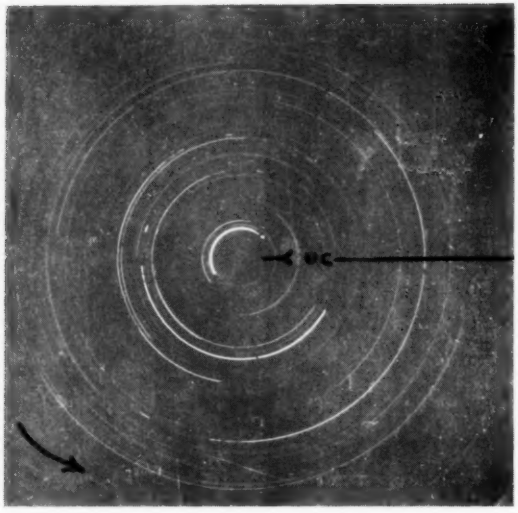


FIG. 4—TYPICAL NIGHT-SKY RECORD
Porton. February 19–20, 1936 ; moon's age : 26 days
U.C. = Upper culmination

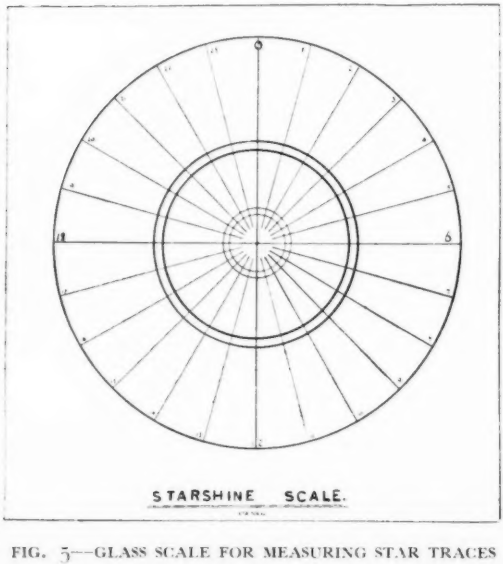


FIG. 5—GLASS SCALE FOR MEASURING STAR TRACES
(see p. 194)

After leaving Broadbalk, a short visit was made to Hoosfield, Little Hoos and Long Hoos. In Hoosfield, experiments on continuous barley began in 1856, using a cross-dressing system. The mineral manures are laid along strips which are crossed at right angles by another set of strips carrying various nitrogenous manures. The effects on the barley crops are very similar to those obtained on wheat on Broadbalk.

On Long Hoos a six-course rotation experiment was started in 1944 and will last for 60 years. It is designed to test the effect of deep (12 in.) ploughing against shallow (6 in.) and of dung and certain fertilizer treatments. This experiment differs from those mentioned above in that the experimental area is divided into small plots, each of which will finally have carried all the series, sugar beet, barley, seeds, wheat, potatoes, oats with various ploughing and manurial treatments.

Dr. Penman gave the party an outline of the work of the Physics Department. The research which is now being carried out includes the study of the properties of clays, and meteorological experiments mainly concerned with micro-climatology.

Potato blight is caused by a virus which is carried by the peach aphis and, in order to study the effect of weather on these aphids, the plant pathologists have asked for the microclimate of potato fields to be investigated. The Physics department has therefore devised an instrument using thermistors to measure dry- and wet-bulb temperatures and wind speeds at various heights, and an attempt is also being made to record radiation on similar principles.

The Meteorological Enclosure in Great Field contains the equipment to give standard climatological observations and also many others for which Rothamsted has long been noted; these include drainage through bare soil 20, 40 and 60 in. deep, evaporation from open water surfaces and from bare soil, and transpiration from turf. Continuous records of dew point are also made, the method of recording depending on the fact that the dew point is roughly as far below the wet-bulb temperature as the wet-bulb is below the dry-bulb temperature. Wind, temperature and humidity are also recorded from various heights on the 105-ft. tower which was installed to study the drift of insects in the air.

In the Plant Pathology Department Dr. Gregory briefly described the work now in progress on the virus diseases of both the persistent and non-persistent types. Once again the importance of microclimates became evident as a factor in the transmission of both virus and epidemic fungus diseases.

There was time for no more than a short visit to the electron microscope, the principles of which were explained by Mr. Nixon. By way of demonstration we saw a zinc-oxide smoke magnified some 10,000 times.

After tea the President expressed the Society's thanks to all the Rothamsted staff who had helped to make the meeting so enjoyable. In his reply the Director, Dr. Ogg, said that he and his staff would welcome any of the Fellows who would care to return to study particular aspects of the work in greater detail.

LETTERS TO THE EDITOR

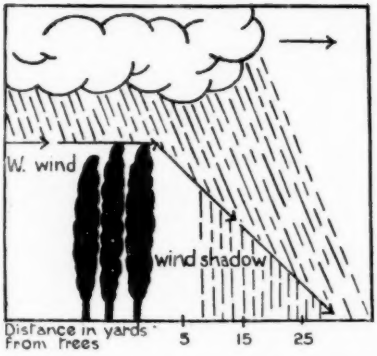
Rain shadow

On the western edge of a large rectangular garden in the country near Hanover, there is a row of poplar trees 35–40 yards high and 20 yards broad. Even in the wet summer of 1946 the western part of the garden showed signs of aridity but in 1947, over the western third, vegetation, including the relatively deeply rooted gooseberry and raspberry bushes, withered away. As the garden is in the middle of a hollow with good subsoil-water conditions these effects of dryness could only be attributed to the rain-shadow effect of the poplars.

Readings with rain-gauges over the period May 1 to August 31, 1947, at varying distances from the row of trees gave the following results :—

Distance east of the poplars (yd.) ..	0–5	5–15	15–25	35
Measured rainfall (mm.)	8–33	33–76	76–110	110
Long-period average (mm.) ..	—	—	—	175

The effect of the trees was enhanced, in the summer of 1948, by the rainfall occurring in the form of showers accompanied by westerly squalls.



Visual observations during showers showed that the portion up to five yards from the trees received only drizzle forced through them with some drippings from the leaves after the shower. The next section, from 5 to 15 yards, received the heaviest drops and the section, from 15 to 25 yards, received a larger quantity and in winds of force 3 to 5 the full intensity of the shower. Only beyond 25 yards was the shower always received at full strength. The general picture is shown in the diagram.

W. LAMMERT

(20*b*) *Einbeck/Hanover, Bismarkstr.* 21

[Mr. Hogg points out that Hudleston (*British Rainfall* 1928) found that a gauge the same distance from a wood as the height of the trees caught only 70 per cent. of the rainfall measured under a standard exposure nearby during a period of westerly winds in winter. Herr Lammert's measurements are thus large compared with Hudleston's particularly as the former were made in summer and the latter in winter but possibly the difference in the breadths of the belts of trees accounts for the difference between them.—Ed. *M.M.*]

Evaporation shadow

The following phenomenon in connexion with the effect of sunshine upon evaporation may be of interest.

The afternoon of June 3, 1948, was showery with squally westerly winds and intermittent sunshine. At about 1435 G.M.T. I noticed that although the tar macadam path leading to the office was perfectly dry, there was marked on this path a perfect shadow of a gate as " wet earth ". There had previously been a sharp shower which terminated at about 1405 and this was followed by a period of brilliant sunshine. When I observed the phenomenon the sun was obscured by cloud. I remained at the gate for a few moments so that I could watch the sun cast the shadow of the gate on the path. This shadow was almost coincident with the wet one.

J. E. BELASCO

June 4, 1948

Thunderstorm observations

Following Mr. Golde's note in the March issue of the *Meteorological Magazine*, it may be useful to record that many of the details asked for in the proposed census of thunderstorms have already been collected by the Thunderstorm Census Organization since 1924, and by Mr. C. J. P. Cave prior to that date, working in conjunction with the Meteorological Office.

A network of about 3,000 observing stations has been built up in the British Isles, with the aid of the observers of the British Rainfall Organization, radio appeals and the help of the Country Press. Some of the results have been published in the *Quarterly Journal of the Royal Meteorological Society*, but the majority have appeared in *British Thunderstorms*. Other data are available through the inquiry service of the Thunderstorm Census Organization at its Headquarters at Langley Terrace, Oakes, Huddersfield.

Daily charts of storm areas have been prepared for a number of years and a series of monthly and quarterly distribution maps have been published. Storm tracks have been worked out in numerous cases, and maps, showing the movement and interaction of storm fronts by means of hourly isochrones, have been published for certain dates.

The " isokeraunic level " method has not been used, in that it has been possible to replace the somewhat loose definition of " thunder heard " by the much more definite indication of " thunder overhead " or within a mile either vertically or horizontally. It is clear that if two storms on different days run on almost parallel tracks, separated by, say ten miles, the " thunder heard " method is likely to give a reading of two for the intervening country between the tracks, while the " overhead storm " method will give the correct result of zero. The suggestion of separate storms on almost parallel tracks is not merely a technical situation chosen to illustrate a method, but an arrangement which very frequently happens on account of the nature of thunderstorms and the manner in which they develop and move.

The analysis of data involves considerable triangulation between groups of stations and between stations within a group; in this way it becomes possible to maintain a reasonable 24-hour watch without the responsibility of excessive hours of observation resting on particular observers.

Data regarding the number of lightning flashes to earth have been collected from time to time, but it has not been found easy to analyse these records with any degree of definiteness. The personal factors of the observers and the influence of their surroundings are matters which are difficult to assess. It has been found much more valuable to ask for reports of actual damage—which a great number of people may be expected to record with both great accuracy and sustained interest—and to plot these indications on the thunderstorm maps. In this way " areas of damage " can be arrived at and classified. Thunder or lightning occurs somewhere in the British Isles on about one day in two, and " areas of damage " occur quite frequently. Thousands of records of damage have been collected and indexed, including some six or seven hundred of damage to trees alone.

If any evidence outside the existing questionnaires of the Thunderstorm Census Organization is required, it would be easy to extend or modify the present arrangements and observing network. Damage map folders on the scale of two miles to the inch were issued about 1935 in order that Observers could plot their local damage.

S. MORRIS BOWER

Thunderstorm Census Organization
Langley Terrace, Oakes, Huddersfield, June 25, 1948

In the March issue of this journal a short article was published under the above heading. The purpose of this article was to enlist voluntary observers with a view to submitting data on the occurrence of thunderstorms with particular reference to the frequency of lightning strokes to earth.

I was, of course, aware of the excellent work done in the meteorological field by the Thunderstorm Census Organization under the direction of Mr. Morris Bower. The Thunderstorm Census Organization, which has been in operation since 1924, has built up a large body of observers and has published several publications giving detailed information on annual thunderstorm activities up to the year 1937.

It is understood that the information received by this organization is examined and tabulated in three ways :—

(1) number of days with thunder heard,
(2) areas of overhead storms, and
(3) areas in which damage has been reported.

While the value of the information collected by the Thunderstorm Census Organization is of undoubted value to the meteorologist it will be recognised that the new survey initiated in the March issue of this journal seeks to obtain more highly specific information. As explained before, thunderstorms which produce no lightning strokes to earth do not affect the continuity of electricity supply and are therefore of no direct interest in the present investigation. Of the three above items the one mentioned last may come nearest the information required for the new census. However, it must be realised that, in the majority of cases, no noticeable damage results from a lightning flash to earth, and that even if damage is done it may often be so slight as to escape notice.

The observation of thunderstorms with respect to the frequency of discharges to earth and the general severity of the storm require the full attention of any observer. It is for this reason that the new survey has been started. A number

THUNDERSTORM OBSERVATIONS

Approximate Time and Duration of Storm .....

.....

Direction of Movement of Storm .....

.....

.....

Severity of Storm .....

.....

.....

Estimate of Number of Lightning Flashes to Earth .....

.....

.....

.....

Date ..... **Signed** .....

of offers of assistance have already been received and helpers have been supplied with postcards on which their observations are to be submitted. The form of this postcard can be seen from the illustration above. Additional observers will be most welcome and they are requested to write to The British Electrical and Allied Industries Research Association, 5 Wadsworth Road, Perivale, Middlesex.

R. H. GOLDE

British Electrical and Allied Industries Research Association,
5 Wadsworth Road, Perivale, Middlesex, July 13, 1948

NOTES AND NEWS

Turbulence in clear air near a warm-front surface

In general, marked turbulence is not expected in a warm front in temperate regions except in those rather exceptional circumstances when considerable instability exists in the warm air mass, and in the latter case considerable cloud development would also be expected. The following is an account of rather different circumstances met by a British meteorological reconnaissance aircraft over the North Atlantic in January 1948. The meteorological observations were made by F/Sgt. A. S. Goodin and the aircraft was an R.A.F. Halifax specially equipped for meteorological reconnaissance.

At 1400 G.M.T. on January 15, 1948, the aircraft carried out a climb from near the sea surface to 500 mb. (18,000 ft. approximately) in 54°50′N. 21°50′W. At this position a layer of cold air flowing from NW. was being replaced at high levels by warm air. The associated warm front was placed on the surface charts as 300 miles to the south-west. This front lay north-west to south-east and was advancing north-east at about 10 kt. In the immediate vicinity of the ascent the clouds consisted of 5 tenths cumulus, base 940 mb.

top 830 mb.; 3 tenths cumulus, base 950 mb. top 690 mb.; and 4 tenths cirro-stratus, base above 500 mb. The top of the cold air was reached at 600 mb. (−13°F.) from which level there was an inversion to 540 mb. (−11°F.) followed by an isothermal to the top of the ascent (500 mb.). From the top of the ascent the warm-front cloud could be clearly seen to the south-west. At the bottom of the ascent there was some intermittent moderate bumpiness but this died out during the ascent, the air at 500 mb. being quite smooth. No special observation regarding bumpiness was made during the climb.

After the ascent the aircraft flew north-east (i.e. away from the front) and in the first 50 miles the temperature fell 10°F. Immediately after the fall in temperature severe turbulence was encountered but all this time the aircraft was in clear air. After the first 50 miles the tops of the cumulus (and cumulo-nimbus) reached 500 mb. and normal intermittent bumpiness occurred.

These observations are of interest in that the exact location of the turbulence with respect to the frontal surface was accurately observed and also in that the aircraft was not in cloud at the time of the severe turbulence. It is not known whether the turbulence was purely due to the lapse rate, possibly associated with clouds rising up at some distance below, or whether the sloping inversion the aircraft flew through had something to do with it.

C. J. M. AANENSEN

Institute of Navigation

On Friday May 21, 1948, in the lecture hall of the Royal Geographical Society, Mr. Francis Chichester read a paper to the Institute of Navigation entitled "Meteorology in aviation: is it obsolete?" The Chair was taken by Air Chief Marshall Sir John Slessor, K.C.B., D.S.O., M.C.

Mr. Chichester commenced by contrasting the aviation requirements of the nineteen twenties with those of the present day. Then forecasts of wind speed were very necessary because of the low speed of aircraft. Fog was a very great menace and forecasts of visibility for landing were essential, as no instrumental aids were available. Cumulonimbus cloud and icing were not feared so much. Today we have a very different picture. Owing to heavy wing loading, cumulo-nimbus cloud is greatly feared, but Mr. Chichester stated that the pilot can use his "radar" scanner to locate cumulonimbus and does not require a forecast. He also said that forecasts of icing conditions are unnecessary today, since, if an aircraft commences to collect ice, the pilot has only to turn on his de-icing equipment and get out of the icing area as quickly as possible.

Mr. Chichester went on to discuss whether forecasts of wind speed were needed. In the case of short flights he suggested they were not, since aircraft speeds have increased so much that the wind makes little difference. For landing it was necessary to know the wind speed and direction but these could be obtained from Flying Control. The case for dispensing with wind forecasts on a long flight required more consideration, and, taking a high-level crossing from Shannon to Gander as an example, Mr. Chichester discussed at some length a contour chart of the height of the 500-mb. pressure surface with a "low" between mid Atlantic and Newfoundland. By flying at a constant pressure level of 500 mb. and from his own determinations of wind, the navigator could estimate by the change in wind direction when he was approaching the "low". He could then make a diversion round the north side of the "low" to

take advantage of favourable winds, and complete the crossing to Gander by "single heading" technique. Mr. Chichester suggested that this method might need considerable investigation, but he did not disclose how any estimate of fuel load could be made at all, unless a forecast of wind speed over the Atlantic was obtained before the aircraft left Shannon.

Finally Mr. Chichester came to the question of fog and made the rather astounding statement that the problem of safe landing in fog by instrumental aids would have been solved before now, if it had not been that in the past pilots had relied too much on visibility forecasts in order to avoid landing in fog.

In the discussion that followed the fallacies of at least some of Mr. Chichester's arguments were exposed. Mr. H. H. Lamb appealed for a better understanding between airmen and meteorologists, and suggested that too much dependence should not be placed on instruments, since even these fail at times. Referring to the 500-mb. contour chart discussed by Mr. Chichester, he asked what would have happened to the aircraft if the "low", instead of being between mid Atlantic and Gander, had been beyond Gander. Mr. R. A. Hamilton said that on at least 25 per cent. of occasions in winter, direct flight between Prestwick and Gander was not possible for the average civil aircraft. How was the pilot to know of these occasions if there were no forecasts? What happened too, when an aircraft flew into icing conditions so severe that the de-icing equipment could not cope with them?

Mr. F. Entwistle (Acting Assistant Secretary-General to the Air Navigation Bureau I.C.A.O.) said that Mr. Chichester's knowledge of modern meteorological procedure and practice was not up to date. There was a very great deal in meteorology besides forecasting. The original forecast was only part of the organization involved in an Atlantic crossing. The pilot, navigator and air traffic controller all needed meteorological information. Pressure-pattern flying technique could be used in flight to improve the intended course in respect of duration of flight. Pilots and navigators agree that forecasts for transatlantic flights are generally good.

The Chairman, in some brief closing remarks, stressed the need for full co-operation between airmen and meteorologists, and pointed out that the critical fuel consumption of the newer types of aircraft would lead to increased demands for meteorological information.

It will be apparent from the above account of the paper that Mr. Chichester's diatribe was really directed against the usefulness of aviation forecasts, and it is not thought that even he would propose to dispense with the whole of the present meteorological organization.

OBITUARIES

Sir D'Arcy W. Thompson, F.R.S.—We regret to record the death on June 21 of Sir D'Arcy Thompson, Professor of Natural History in the University of St. Andrews for 64 years.

Meteorology was one of Sir D'Arcy Thompson's many interests particularly in its connexion with oceanography and fisheries. He wrote papers on the surface temperature of the North Sea and North Atlantic published in the Reports of the Fishery Board of Scotland. From 1938 he was the member of the Meteorological Committee nominated by the Royal Society of Edinburgh.

Mr. R. Feige.—We record with regret the death, as the result of wounds received during hostilities in Jerusalem, on May 28, of Mr. R. Feige, well known to many British meteorologists as Government Meteorologist of Palestine.

Mr. Feige commenced meteorological work in Germany where he became Director of the Meteorological Observatory of Breslau. Joining the Meteorological Service of Palestine, following emigration to that country in the late nineteen thirties, he became meteorological officer at Lydda airport. In 1940 he was appointed Government Meteorologist under the Director of Civil Aviation.

Mr. Feige took a prominent part in the revival of international meteorological work since the war and at the time of his death was a member of seven International Meteorological Organization Committees and Commissions and Vice-President of the Commission for Agricultural Meteorology. In the absence of the President of the Agricultural Meteorology Commission he was appointed acting President of that Commission during its meetings at Toronto and led its discussions with marked ability.

Mr. Feige was particularly interested in the applications of meteorology to aviation, medicine and agriculture, and wrote papers on all those subjects. Perhaps his principal work was his " Rainfall Atlas of Palestine " compiled in collaboration with E. Rosenau.

In the last few months before his death he was actively engaged in making arrangements for founding a journal of agricultural meteorology.

He will be remembered not only as a meteorologist of wide interests but also as a genial and entertaining host at his home in Jerusalem.

REVIEW

Plain Words. A guide to the use of English, by Sir Ernest Gowers. 8vo., $8\frac{1}{2}$ in. $\times$ $5\frac{1}{2}$ in., pp. vi + 94, London, H.M.S.O. 1948. Price 2*s.* 0*d.* net.

Sir Ernest Gowers wrote this little book at the request of the Treasury to help officials in their use of written English. Legal English is expressly excluded, because in laws and regulations the need for absolute exactness is paramount, and may have to be attained at the expense of easy readability. In all other official writing, clarity of expression is essential, and he shows how, with a little care in the choice of words, clarity can be obtained. The time of even the busiest official is not wasted by such care, for not only may it save unnecessary correspondence; clarity of expression means clarity of thought and therefore efficiency. Many examples are given, under the headings of " Correctness ", " The Choice of Words " (avoiding the superfluous word, choosing the familiar word, choosing the concrete word), " The Handling of Words " and "Punctuations ". The book makes amusing reading, but the reader who takes it to heart will be a better writer for it.

Meteorologists will be interested to see that Sir Ernest defends the use of " weather conditions ", as opposed to plain " weather ", against an attack in *The Times*. He writes: " *Weather conditions* imports a larger idea than *weather* does, at least in time of snow and frost. It embraces the conditions created by yesterday's weather and the likelihood of to-morrow's weather changing them." But he disqualifies the statement that " *blizzard conditions* had returned

to the Midlands ": it was not blizzard conditions that had returned; it was a blizzard. He concludes that the Meteorological Department is too fond of " conditions ".

In scientific as in other forms of writing the clearest sentences are generally short, but at times the complexity of the idea to be expressed needs a long one. Sir Ernest quotes Mark Twain on how the author should deal with these exceptions:—

> "At times he may indulge himself with a long one, but he will make sure that there are no folds in it, no vaguenesses, no parenthetical interruptions of its view as a whole; when he has done with it, it won't be a sea-serpent with half of its arches under water, it will be a torchlight procession."

NEWS IN BRIEF

All British meteorologists, particularly those who served at Dunstable between 1942 and 1945, will be pleased to hear that the King has approved the appointment of Dr. Sverre Petterssen as an honorary C.B.E. in recognition of his war service with the Meteorological Office and Royal Air Force.

Dr. G. C. McVittie, a member of the Meteorological Research Committee, has been appointed to the new chair of Mathematics at Queen Mary College, University of London.

At Hamburg, the University Meteorological Institute, the centre for earthquake research, and the University Institute of Oceanography have been amalgamated to form the Geophysical Institute of the University of Hamburg. The address is Hamburg 13, Rothenbaumehausee 33.

WEATHER OF JULY 1948

During the first 16 days of the month pressure was persistently high to the west of the British Isles and low on the continent. From the 6th to the 9th the high pressure extended from the Azores at least to northern Greenland. Between the 17th and 21st depressions moved eastwards across and to the north of the British Isles. On the morning of the 21st, one of unusual intensity for July, covered Ireland with pressure about 986 mb. near the centre. As this depression moved away towards Norway an anticyclone spread from the south-west and passed across northern France and Belgium, reaching the Baltic and central Europe by the 24th. Pressure remained high to the east and north-east of the British Isles during the rest of the month.

Mean pressure for the month was above 1020 mb. around the Azores. It was above 1015 mb. from southern Europe across to the east coast of the United States and in the north-east of Greenland and Spitsbergen. There were areas slightly below 1010 mb. in the extreme south-west of the United States and Canada. Pressure was about 5 mb. above normal around Spitsbergen and Bear Island, but was generally not far from normal over Europe and North America.

The cool weather which set in at the end of June persisted until July 17. During this spell pressure was high on the north-east Atlantic and low to the east of the British Isles, depressions near Iceland moving south-east or south around the anticyclone. Cool winds prevailed, mainly between north and west, with rain especially on the 3rd, 4th, 7th, 8th, 10th–13th. A change

occurred on the 17th when a depression approached west Scotland and subsequently remained almost stationary off the Hebrides, while secondaries moved north-east or north over the British Isles. Fairly heavy rain occurred in the southern half of England on the 17th ; temperatures rose to 79°F. at Gorleston on the 19th. On the 20th a deep depression approached west Ireland and subsequently moved rather quickly north-east across the country causing strong winds and gales at exposed places on the 21st; wind speed in gusts reached 71 m.p.h. at Pembroke and Holyhead, and 63 m.p.h. at Aberporth. According to the *Daily Telegraph* pleasure sailings in the west were cancelled or delayed and considerable damage occurred to fruit in the Vale of Evesham. By the 26th a wedge of high pressure extended south-west from an anticyclone over the Baltic to our south-eastern districts and later spread northward to influence the whole country. Temperatures rose rapidly, reaching or somewhat exceeding 86°F. locally in the south-east on the 26th and rising to 90°F. at a number of places on the 28th and 29th. During the last 3 days a trough of low pressure over our south-west districts moved slowly north and by the 31st covered the British Isles. Thunderstorms occurred in southern districts on the 28th–30th. On the 28th, at Marlborough, Wilts., houses and trees were struck by lightning; there were heavy squalls of wind at the peak of the storm and trees were uprooted. Heavy thunderstorms occurred in north-west England on the 31st; at Southport 1·68 in. of rain fell in 35 minutes. Considerable fog occurred on our south-west coasts and in the Channel on the 30th–31st.

Rainfall was considerably below the average over much of England and Wales and south-east Scotland but with local variation due to heavy falls in thunderstorms. The latter were severe locally in the period 28th–31st.

Mean temperature was very slightly below the average in most areas. The first 17 days were exceptionally cool but the last week was extremely hot. The maximum on the 28th was 94°F. at Mildenhall and South Farnborough and 93°F. at Kew Observatory, a record there for July; the 29th was the hottest July day at Southport since 1873 (90°F. at Hesketh Park). During the night of 28th–29th the screen temperature at Kew did not fall below 70°F., the highest minimum value recorded there, exceeding the readings of July 28, 1947 and July 13, 1923.

In spite of the brilliant sunshine during the last week, the duration of bright sunshine for the month was generally below the average in England and Wales but in Scotland and Northern Ireland there was some excess.

The general character of the weather is shown by the following table:—

	Air Temperature			Rainfall		Sunshine	
	Highest	Lowest	Difference from average daily mean	Percentage of average	No. of days' difference from average	Percentage of average	Percentage of possible duration
	°F.	°F.	°F.	%		%	%
England and Wales	95	34	−0·5	62	−3	93	35
Scotland ..	90	34	0·0	102	−2	103	29
Northern Ireland..	86	39	−0·4	97	−3	103	31

RAINFALL OF JULY 1948

Great Britain and Northern Ireland

County	Station	In.	Per cent of Av.	County	Station	In.	Per cent of Av.
London	Camden Square ..	1·06	45	*Glam.*	Cardiff, Penylan ..	4·29	139
Kent	Folkestone, Cherry Gdns.	2·72	130	*Pemb.*	St. Ann's Head ..	2·44	94
,,	Edenbridge, Falconhurst	1·13	49	*Card.*	Aberystwyth	2·83	93
Sussex	Compton, Compton Ho.	1·83	65	*Radnor*	Bir. W. W., Tyrmynydd	2·63	64
,,	Worthing, Beach Ho.Pk.	1·18	58	*Mont.*	Lake Vyrnwy	..	..
Hants	Ventnor, Roy. Nat. Hos.	1·61	80	*Mer.*	Blaenau Festiniog ..	6·80	80
,,	Bournemouth	1·18	55	*Carn.*	Llandudno	1·55	69
,,	Sherborne St. John ..	1·32	59	*Angl.*	Llanerchymedd ..	2·75	96
Herts.	Royston, Therfield Rec.	1·38	55	*I. Man.*	Douglas, Boro' Cem. ..	2·48	81
Bucks.	Slough, Upton	·93	48	*Wigtown*	Port William, Monreith	2·64	94
Oxford	Oxford, Radcliffe ..	·85	36	*Dumf.*	Dumfries, Crichton R.I.	2·79	85
N'hant.	Wellingboro', Swanspool	1·28	56	,,	Eskdalemuir Obsy. ..	3·99	97
Essex	Shoeburyness	·97	53	*Roxb.*	Kelso, Floors	1·13	43
Suffolk	Campsea Ashe, High Ho.	1·35	59	*Peebles*	Stobo Castle	2·79	96
,,	Lowestoft Sec. School ..	1·63	72	*Berwick*	Marchmont House ..	1·56	51
,,	Bury St. Ed., Westley H.	1·64	66	*E. Loth.*	North Berwick Res. ..	1·23	48
Norfolk	Sandringham Ho. Gdns.	1·85	72	*Midl'n.*	Edinburgh, Blackf'd. H.	1·94	69
Wilts.	Bishops Cannings ..	·77	31	*Lanark*	Hamilton W. W., T'nhill	2·38	83
Dorset	Creech Grange.. ..	1·72	70	*Ayr*	Colmonell, Knockdolian	2·91	92
,,	Beaminster, East St. ..	1·29	50	,,	Glen Afton, Ayr San ..	..	..
Devon	Teignmouth, Den Gdns.	·70	30	*Bute*	Rothesay, Ardencraig	4·95	125
,,	Cullompton	1·71	64	*Argyll*	L. Sunart, Glenborrodale	4·15	89
,,	Barnstaple, N. Dev. Ath.	2·00	74	,,	Poltalloch	3·84	93
,,	Okehampton, Uplands	2·52	78	,,	Inverary Castle	6·66	134
Cornwall	Bude School House ..	2·06	84	,,	Islay, Eallabus ..	4·83	142
,,	Penzance, Morrab Gdns.	2·10	77	,,	Tiree	3·80	105
,,	St. Austell, Trevarna ..	2·27	68	*Kinross*	Loch Leven Sluice ..	3·55	123
,,	Scilly, Tresco Abbey ..	1·47	66	*Fife*	Leuchars Airfield ..	1·55	60
Glos.	Cirencester	·91	35	*Perth*	Loch Dhu	6·62	137
Salop.	Church Stretton ..	1·41	53	,,	Crieff, Strathearn Hyd.	2·76	93
,,	Cheswardine Hall ..	2·14	79	,,	Blair Castle Gardens ..	..	..
Staffs.	Leek, Wall Grange P.S.	2·26	70	*Angus*	Montrose, Sunnyside ..	2·50	95
Worcs.	Malvern, Free Library	·91	40	*Aberd.*	Balmoral Castle Gdns...	2·53	99
Warwick	Birmingham, Edgbaston	..	..	,,	Dyce, Craibstone ..	2·69	89
Leics.	Thornton Reservoir ..	1·24	50	,,	Fyvie Castle	2·93	90
Lincs.	Boston, Skirbeck ..	1·45	66	*Moray*	Gordon Castle	3·30	103
,,	Skegness, Marine Gdns.	1·73	79	*Nairn*	Nairn, Achareidh ..	2·46	96
Notts.	Mansfield, Carr Bank ..	1·28	49	*Inv's*	Loch Ness, Foyers ..	5·25	174
Ches.	Bidston Observatory ..	2·58	100	,,	Glenquoich	7·92	123
Lancs.	Manchester, Whit. Park	2·58	78	,,	Fort William, Teviot ..	7·05	144
,,	Stonyhurst College ..	2·49	64	,,	Skye, Duntuilm ..	4·16	111
,,	Blackpool	2·06	71	*R. & C.*	Ullapool	2·30	75
Yorks.	Wakefield, Clarence Pk.	1·41	56	,,	Applecross Gardens ..	4·65	116
,,	Hull, Pearson Park ..	·83	35	,,	Achnashellach	5·61	115
,,	Felixkirk, Mt. St. John	1·59	58	,,	Stornoway Airfield ..	2·60	90
,,	York Museum	1·19	47	*Suth.*	Lairg	1·84	59
,,	Scarborough	1·49	61	,,	Loch More, Achfary ..	7·02	131
,,	Middlesbrough.. ..	·79	31	*Caith.*	Wick Airfield	1·74	66
,,	Baldersdale, Hury Res.	·90	28	*Shet.*	Lerwick Observatory ..	3·22	141
Nor'd.	Newcastle, Leazes Pk. ..	·84	33	*Ferm.*	Crom Castle	3·51	101
,,	Bellingham, High Green	·79	24	*Armagh*	Armagh Observatory ..	2·46	85
,,	Lilburn Tower Gdns. ..	·90	36	*Down*	Seaforde	2·63	82
Cumb.	Geltsdale	2·40	70	*Antrim*	Aldergrove Airfield ..	2·51	90
,,	Keswick, High Hill ..	3·17	83	,,	Ballymena, Harryville..	3·33	97
,,	Ravenglass, The Grove	2·20	59	*Lon.*	Garvagh, Moneydig ..	2·99	92
Mon.	Abergavenny Larchfield	·71	29	,,	Londonderry, Creggan	4·80	131
Glam.	Ystalyfera, Wern House	3·86	84	*Tyrone*	Omagh, Edenfel ..	3·41	100

CLIMATOLOGICAL TABLE FOR THE BRITISH COMMONWEALTH, MARCH 1948

Stations	Pressure		Temperatures							Relative humidity	Mean cloud amount	Precipitation			Bright Sunshine	
			Absolute		Mean values											
	Mean of day M.S.L.	Diff. from normal	Max.	Min.	Max.	Min.	½ Max. and Min.	Diff. from normal	Wet bulb			Total	Diff. from normal	Days	Daily Mean	Percentage of possible
	mb.	mb.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	%	tenths	in.	in.		hr.	%
London, Kew Observatory	1027·6	+14·7	71	33	55·6	40·3	47·9	+4·8	43·4	82	5·9	0·58	−1·11	7	4·4	37
Gibraltar	1025·1	+8·0	75	49	65·7	56·8	61·3	+3·7	57·6	83	7·0	0·69	—	7	5·0	42
Malta	1024·0	+9·8	70	44	61·5	49·5	55·5	−1·6	53·7	72	5·3	0·71	—	5	8·2	69
St. Helena	1014·5	−0·1	81	61	74·3	62·6	68·5	+3·0	62·6	95	7·1	4·82	+0·70	18	—	—
Freetown, Sierra Leone	1010·8	+1·6	90	72	85·7	76·6	81·1	+0·2	76·7	81	4·5	0·28	−0·88	2	7·8	65
Lagos, Nigeria ..	1010·4	+1·5	94	67	91·0	72·2	81·6	−1·8	77·3	79	6·2	2·15	—	6	5·3	44
Kaduna, Nigeria ..	1009·1	—	99	61	92·0	67·1	79·5	−2·1	59·4	24	4·3	0·11	−0·43	1	7·4	62
Chileka, Nyasaland	1012·7	−0·2	87	65	83·1	67·2	75·1	+1·6	70·3	77	5·9	4·68	−1·91	12	6·2	51
Lusaka, Rhodesia ..	1010·3	−0·4	83	60	79·5	63·1	71·3	+1·0	65·6	87	8·0	6·41	+0·20	20	4·9	—
Salisbury, Rhodesia	1011·6	−0·5	82	58	76·8	60·7	68·7	+1·0	63·3	80	7·3	5·54	+0·84	23	5·1	42
Cape Town	1014·7	+0·2	89	50	77·4	58·5	67·9	−0·2	58·7	75	6·5	1·58	+0·70	11	—	—
Germiston, South Africa	1012·1	—	79	52	73·9	57·6	65·7	—	58·2	83	6·7	3·98	—	15	6·3	52
Mauritius	1012·6	+0·7	90	69	86·5	72·5	79·5	+1·5	73·4	79	5·2	3·62	−4·97	25	8·0	65
Calcutta, Alipore Obsy.	1010·3	+0·2	100	57	92·2	69·2	80·7	+0·5	69·3	76	2·4	4·82	+3·44	5	9·0	75
Bombay	1010·0	−0·9	95	69	89·3	73·5	81·4	+1·9	71·9	77	1·1	0·00	−0·02	0	9·6	80
Madras	1010·7	−0·2	99	67	91·3	74·2	82·7	+1·6	74·5	79	2·9	0·00	−0·34	0	10·3	86
Colombo, Ceylon ..	1010·2	+0·1	92	70	89·2	73·7	81·5	−0·3	73·9	85	4·3	2·63	−1·65	7	9·2	76
Singapore	1009·4	−0·3	92	72	87·5	74·2	80·9	−0·3	76·4	85	7·1	10·00	+2·60	19	—	—
Hongkong	1017·1	+1·1	84	50	73·2	63·5	68·3	+5·0	64·2	82	—	0·80	−2·14	8	3·9	32
Sydney, N.S.W. ..	1017·2	+0·9	88	54	74·7	61·2	67·9	−1·4	61·6	71	5·3	3·61	−1·37	14	6·7	55
Melbourne	1017·7	+0·8	90	42	71·0	50·7	60·9	−3·6	53·5	60	5·3	0·29	−1·89	8	7·5	61
Adelaide	1019·8	+2·7	93	50	75·5	57·0	66·3	−3·6	55·8	45	4·4	0·27	−0·75	3	8·3	61
Perth, W. Australia	1015·5	+0·2	95	56	88·0	65·5	76·7	+5·5	66·0	51	1·0	2·35	+1·54	6	8·6	70
Coolgardie	1017·3	+2·4	98	52	85·5	61·1	73·3	+1·4	60·3	55	3·2	0·08	−0·86	2	—	—
Brisbane	1014·3	−0·1	91	62	82·7	67·5	75·1	+0·8	69·0	72	5·3	6·13	+0·36	12	7·6	61
Hobart, Tasmania																
Wellington, N.Z. ..	1015·7	−1·5	75	47	67·4	55·0	61·2	+1·9	57·1	74	7·3	2·86	−0·47	8	6·3	51
Suva, Fiji	1010·0	+1·6	88	70	84·4	73·9	79·1	−1·0	75·8	86	6·8	14·60	+0·11	25	5·7	47
Apia, Samoa ..	1009·3	+0·3	90	72	87·4	74·5	80·9	+0·5	77·6	78	6·3	3·33	−10·38	19	7·4	61
Kingston, Jamaica																
Grenada, W Indies	1013·6	+0·6	86	67	84·1	74·0	79·1	+1·3	73·8	78	7·2	2·21	−0·45	20	—	—
Toronto	1018·9	+1·6	62	−1	39·9	24·3	32·1	+2·5	26·2	—	7·1	2·58	+0·17	13	4·9	41
Winnipeg	1017·1	−2·1	42	−33	21·9	2·9	12·4	−2·6	6·0	—	6·0	0·77	−0·39	10	5·8	49
St. John, N.B. ..	1018·5	+4·4	55	−8	33·8	17·6	25·7	−2·7	21·0	—	5·9	4·64	+0·10	18	4·9	41
Victoria, B.C. ..	1013·9	−2·0	58	25	48·9	33·0	40·9	−2·6	35·1	94	6·1	3·43	+1·00	11	5·0	42